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III. GEOLOGY AND PALEONTOLOGY.

PHYSIOGRAPHY OF SOUTHEASTERN KANSAS.

BY GEO. I. ADAMS, LAWRENCE.

Read before the Academy October 28, 1897.

The National Geographical Society of Washington has published a volume of monographs entitled "The Physiography of the United States." In this volume Major Powell, of the United States Geological Survey, has discussed physiographic processes and features, and defined in a comprehensive way the physiographic regions and districts of our country. It is the purpose of this paper to discuss briefly the geologic structure of Kansas as relates to the regions with which it has a common history, and in particular to define the physiographic features of the southeastern part of the state.

PHYSIOGRAPHIC REGIONS TO WHICH KANSAS IS RELATED.

The regions to be considered in a discussion of the structural history of Kansas are shown in the accompanying map. The Ozark region embraces the Ozark plateau of southern Missouri and northern Arkansas and the Ozark ranges of eastern Indian territory. The Ozark plateau extends just into the southeastern corner of Kansas. The prairie plains region extends to the north and west of this region. In Kansas it covers about the eastern fourth of the state. It is divided into a glaciated and a non-glaciated district, the division lines running approximately east and west just south of the Kansas and Missouri rivers. West of the prairie plains stretches the Great Plain plateau, terminating at the base of the mountains. That district of this region of which Kansas forms a part is known as the Arkansas plateau. The Park Mountain region embraces the mountains of southern Wyoming, central Colorado, and northern New Mexico. Between these ranges lie the mountain valleys commonly called parks.

REGIONAL BOUNDARIES IN KANSAS.

The regions are defined and mapped in a broad way by Major Powell. Just what are considered the limits in each case is not told. Within the borders of our own state, however, they are manifestly well defined in nature and will admit of closer mapping. The regional boundaries are here, also the boundaries of geological formations. In discussing the physical features of Missouri, Marbut* has made the line of separation between the Carboniferous and the Subcarboniferous the western margin of the Ozark region. In Kansas the line follows Spring river, thus giving the region but a very small extent within the state in the extreme southeast corner. The western limit of the prairie plains is apparently the escarpment along the eastern border of the Permian formation. This is a very natural division, and a traveler passing westward cannot fail to notice the sudden rise in the elevation and the change in surface features. In the southern portion of the state the transition is marked by the Flint Hills.

GEOLOGICAL STRUCTURE OF KANSAS.

The geological structure of Kansas is best understood by reference to a section extending in an east and west direction from the dome of the Ozark region to the

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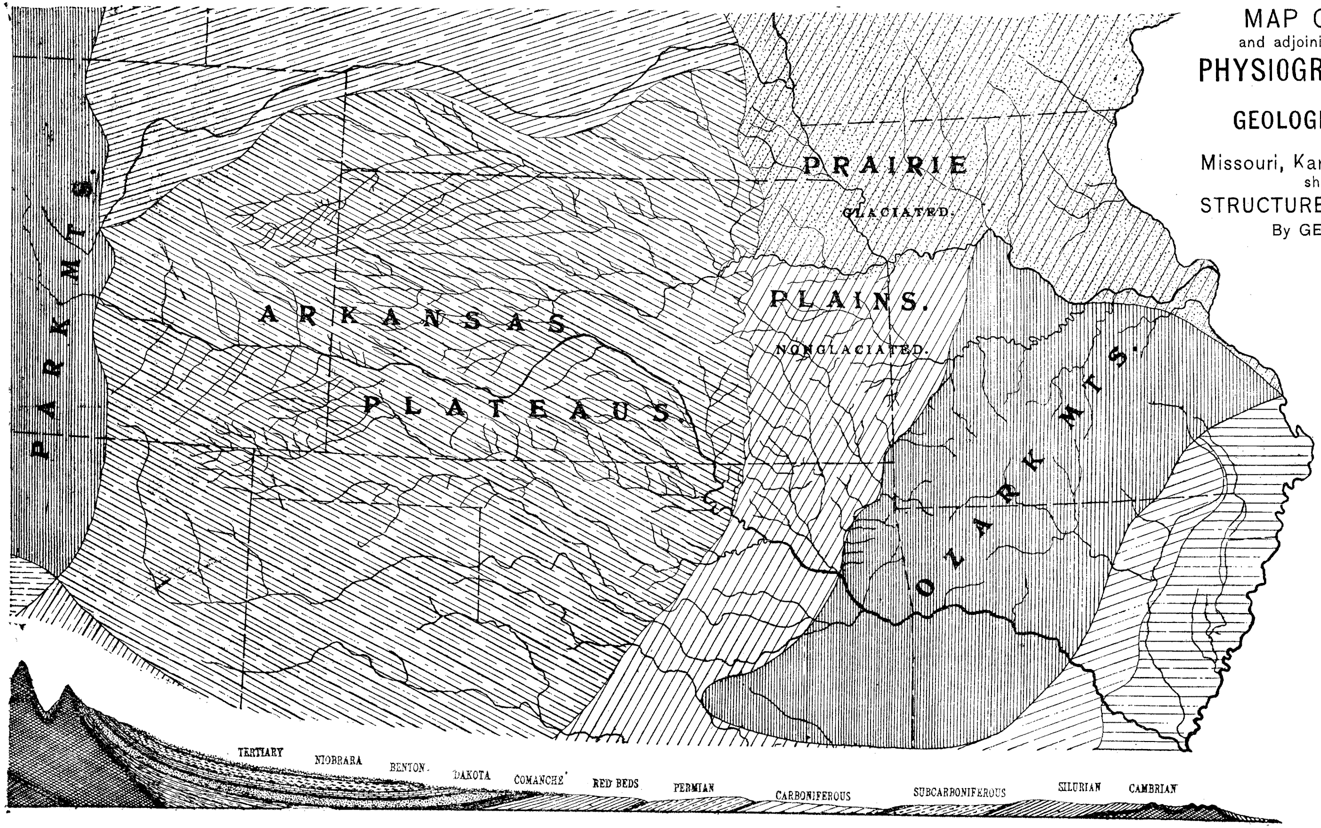
*Physiographic Features of Missouri: Mo. Geol. Surv., vol. X.

PLATE II.



MAP OF KANSAS
and adjoining states, showing
PHYSIOGRAPHIC AREAS,
with a
GEOLOGICAL SECTION
through
Missouri, Kansas and Colorado,
showing the
STRUCTURE OF THE AREAS.
By GEO. I. ADAMS.

(Courtesy of University Geological Survey.)

Park mountains (see map, p. 54). From this section it will be seen that within the Ozark uplift is a core of archean rocks which are exposed within limited areas in southeastern Missouri. Around this core is an area of the older Palæozoic formations. Passing westward, we find the beveled edges of the later Palæozoic formations. Along the line of the section they are represented as follows: First, undifferentiated Cambrian and Silurian and the Subcarboniferous. Within the prairie plains region lies the Carboniferous. The Arkansas plateau region embraces the Permian, the Red Beds (which are referred by some to the Permian and by others to the Triassic), the Comanche, Dakota, Benton, and Niobrara; while resting unconformably upon these is an irregular deposit of the Tertiary. At the base of the Park mountains are the upturned edges of the Cretaceous and older rocks, while within the region the formations are much disturbed and the ranges contain eruptive and archean elements. Kansas may be said to be an area of slight disturbance lying between two mountainous regions, whose complex histories have produced simple oscillations over the regions of the prairie plains and the Arkansas plateaus.

We cannot reconstruct with much certainty the original areas of these various formations, but they once extended much further to the east; and to produce their present surface and beveled outcrops, erosion has been at work at varying intervals and for long periods. The westward dips and the succession from older to newer formations along this section argues in favor of the hypothesis that the shore line during Palæozoic times was to the east. This hypothesis is still further strengthened by the fact that the deposits themselves, show marginal conditions in their eastern outcrops, while the records of deep wells show deep-sea conditions to have been more prevalent to the west, as is indicated by the thinning of shale beds and the thickening of the limestone systems.

That this shore-line made many oscillations and migrations is evidenced from the alternation of oceanic and littoral deposits and the deposits of coal in the upper part and near the westernmost exposures of the Carboniferous. At the close of the Palæozoic era the land area must have advanced much further westward, since the deposits of salt and gypsum in the upper portion of the Permian indicate the absence of open seas. During the whole of the Cretaceous period deep sea conditions prevailed over most of the state, since the deposits are now present in the western two-thirds of it after a considerable erosion. At its close the raising of the mountains to the west caused the final retreat of the sea, the only remaining deposits, the Tertiary and limited Quaternary areas, being of fresh-water origin.

ORIGIN OF PRESENT DRAINAGE.

Until the close of the Cretaceous the drainage of Kansas, or such portions of it as were land areas, was to the west into the Cretaceous sea, since the deposits indicate a land mass to the eastward. The raising of the mountains to the west produced a drainage slope to the east over the newly exposed Cretaceous formations, which subjected them to a considerable erosion before the Tertiary of Kansas was laid down. Just what oscillations have occurred since then are not so easily determined. If, however, the Tertiary deposits were lacustrine to any extent, it would seem probable that there existed during that period a broad basin extending over the western part of the state far to the north and south, into which the drainage from the west flowed. If the sediments which produced the Tertiary were simply spread out on a flood plain, similar conditions probably existed. It appears therefore that not until near the close of the Tertiary times were the Park mountains sufficiently elevated to induce a drainage from that region across the Arkansas plateau to the Mississippi. We may accordingly look upon the present physiography of Kansas as being of the latest period.

DRAINAGE OF THE PRAIRIE PLAINS.

The drainage of the prairie plains is due primarily to the eastward slope of the surface. By reference to the map, it will be seen that, with the exception of the Kansas river, all the streams rise within the area. A secondary feature is the dip and strike of the rocks. In general, the dip is to the west and the streams flow at right angles to the strike, but slight deformations of the strata have caused a deflection of some of the streams to the south. There is an anticlinal ridge which has determined the divide between the Neosho and Osage river systems. In Missouri this divide continues into the Ozark region, to which the anticlinal is, no doubt, structurally related. Near the eastern border of the state this divide is spoken of by the residents as the Ozark ridge, and they will tell you that it can be traced to the Ozark mountains; but many of them mistake the escarpments which cross the ridge for the ridge itself. Along the southern border of the state the dip is to the southwest, and the streams here become more directly tributary to the Arkansas, which finds its way through the Ozark region in a synclinal trough.*

Spring river, which crosses the southeast corner of the state, flows along the line of contact between the Subcarboniferous and Carboniferous formations, and has literally slid down the extreme border of the Ozark dome, eroding the shales of the Carboniferous and accommodating itself to the uneven surface of the Subcarboniferous. In the territory the Neosho, to which Spring river is tributary, occupies a similar position, and is deflected to the west considerably before it reaches the Arkansas.

RESULTANT TOPOGRAPHY.

The formations over which the streams flow are beds of limestone alternating with beds of sandstone and shale. The unequal yielding of these materials to erosive agencies has produced in general a terraced surface, the limestones protecting the escarpments while the shales and sandstones below have been carried away by the streams. †

The inclination of the strata has produced a gradual slope (back slope) from the top of one escarpment to the base of the next higher. Not infrequently a stream cuts off a portion of an escarpment, producing a mound or ridge, and the ridge in turn is broken up into a row of mounds. In case the more resistant strata are anywhere discontinued or lose their importance the escarpment fades out, and the softer beds add their thickness to the escarpment geologically next higher. Likewise if the softer strata give place to more resistant ones, *e. g.*, a limestone system appears in a position where in other cases there is a shale bed, a new escarpment is developed. If a shale bed gradually thins out the adjacent limestones are merged into the same escarpment; and, on the contrary, if two closely associated systems are separated at any place by the thickening of intervening shales, their lines of outcrop diverge and two escarpments are produced.

A stream flowing upon a back slope will gradually slide down upon the inclined strata until it reaches the base of the next escarpment, cuts through the underlying formation, or reaches base level. In the latter case it would widen its valley, producing a plane independent of the dips of the strata. Along a single stream this area would be called a bottom land. When produced over large area by a stream and its tributaries, or by several streams, it is called lowland.

The prairie plains region in Kansas is coextensive with the Carboniferous formation. A section ‡ made from Galena to Grenola passes across the entire formation as here exposed. At its eastern limit we have the break in geological time marked by unconformity; at its western limit the transition to the Permian is marked by the fossils only. The dip of the strata, and the alternation of the easily eroded shales and sandstones with the more permanent limestones, are well exhibited by such a section drawn to scale. The lines of outcrop of the limestone systems have been traced with considerable detail and are quite identical with the escarpments which are shown in the accompanying map. It will be observed that they trend in a northeast and southwest direction, with many sinuosities where they cross the streams and divides.

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* Geo. H. Ashley, Geology of Paleozoic Region of Arkansas: Proc. Am. Phil. Soc., May, 1897.

† *Vide* Haworth: University Geol. Surv. of Kansas, vol. I, ch. 10.

‡ This section, made by the writer, was published in the Univ. Geol. Surv. of Kansas, vol. I; also in vol. III, *q. v.*

DESCRIPTION OF PHYSIOGRAPHIC FEATURES.

Proceeding now to a description of the physiographic features, and beginning with the southeastern corner of the state, we find a small area of Subcarboniferous which belongs to the Ozark region and which forms our starting-point (see map, page 58). To the west of this lie the

CHEROKEE LOWLANDS.

The base of the Carboniferous consists of a bed of shales and sandstones about 450 feet thick, known as the Cherokee shales* and sandstones. They are exposed over a belt of country about twenty-five miles wide, lying between Spring river and Oswego, and extending across the corner of the state far into Missouri and Indian territory. The surface is gently undulating, the monotony of lowland topography being occasionally broken by ridges and mounds which owe their existence to heavy sandstone. Such a mound is the one west of Baxter Springs, near the territorial line. The country around Columbus exhibits a number of sandstone ridges, the city being located upon the divide between Spring river and the Neosho. Within this area are situated Pittsburg, Cherokee, Columbus, Weir City, Mineral, Sherman, and Chetopa. Over this area there are no limestones of stratigraphic importance, those which exist being usually associated with coal seams as "cap rocks." The western border of the Cherokee lowlands is the

OSWEGO ESCARPMENT.

At Oswego we meet with the first important limestones, known from their exposure at that place as the Oswego formation.*

They cap the heavy shale beds and produce an escarpment which along the river bluff is 120 feet high. To the south the escarpment continues west of the Neosho river, passing into Indian territory; to the northeast it passes Sherman and produces the hills around Monmouth and to the northwest of Mineral City. Just north of Cherokee it bends to the north, crosses Cow creek near Girard, and runs a little north of east almost to the state line, being very prominent at Mulberry, from which place it bends to the north, passing in a sinuous line west of Arcadia, Bunker Hill being a part of it. From there to Fort Scott it is very irregular and has many outlying hills. East of Fort Scott it reaches the state line, but bends back up the Marmaton, and, after crossing the river, finally passes into Missouri. It is in this escarpment that coal is obtained by quarrying the limestone above it. The Oswego formation extends but a short distance to the west on the surface. The next formation met with is the Pawnee, producing the

PAWNEE ESCARPMENT.

The Pawnee limestone† formation produces but a slight influence upon the topography. To the north it becomes more important, and is seen in the escarp-

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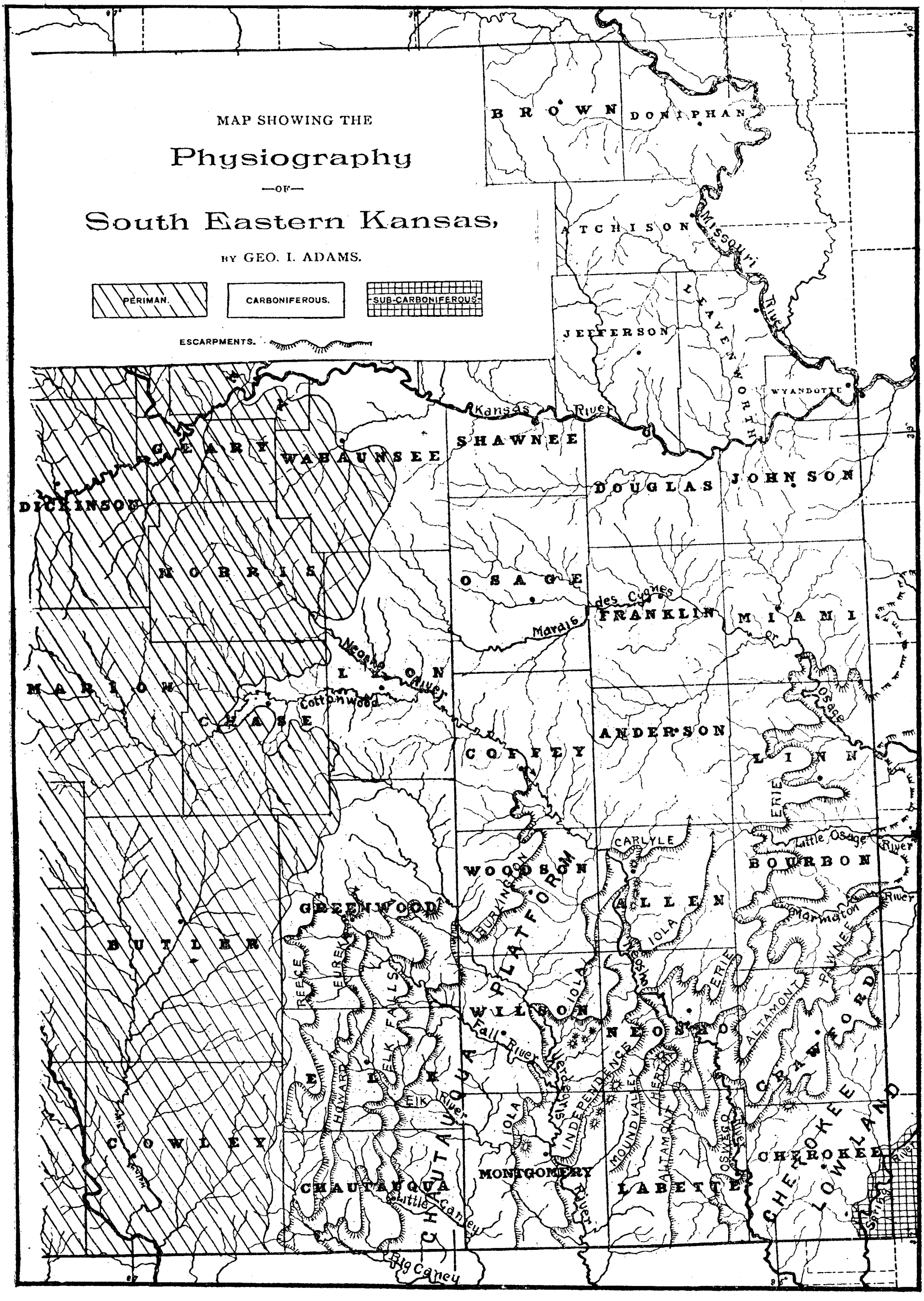
* Haworth and Kirk: Kans. Univ. Quart., vol. II. p. 105.
† Haworth and Kirk: Univ. Geol. Surv., vol. I, ch. 2.



(Courtesy of University Geological Survey.)

ment crossing the divide between Labette creek and the Neosho near Laneville. East of the Neosho it passes McCune to the south and runs up Lightning creek, crossing it near its head, from which place it follows a sinuous line, north of Girard, west of Englevale and east of Pawnee station, to Godfrey, where it blends with the Oswego escarpment.

ALTAMONT ESCARPMENT.

The next limestone formation is the Altamont. It is found at the top of the escarpment which, passing east of Altamont and extending to the south, runs just east of Edna and into the territory, becoming very prominent there. Tracing the systems to the north, they are found to pass from Altamont north to Parsons, at which place they produce no escarpment. Along the west bluff of the Neosho they are again important, but the escarpment fades out around St. Paul, in the Neosho bottoms. To the northeast, past Braziltou, Farlington, and Hiattsville, there is a prominent escarpment; but it is largely due to the thick sandstone beds which produce the flagging stone quarried at many places. In the valley of the Marmaton the escarpment disappears, but is again found further north.

ERIE ESCARPMENT.

This escarpment is most prominent along the Marmaton river near Uniontown, from which place it runs to the northeast, passing out of the state east of La Cygne, according to Mr. Bennett, who is familiar with that region. Following it to the south, it passes east of Savonburg nearly to Walnut, thence westward north of Erie, where it crosses the Neosho river. It is produced by three limestone systems called collectively the Erie formation.*

They are quite closely associated along the course already described, and the escarpment is one of the most prominent in the southeastern portion of the state. South of the Neosho, however, the systems separate, due to the thickening of the intervening shale beds, and the lines of their outcrops diverge.

HERTHA ESCARPMENT.

The lower member trends to the east around the head of a creek to Hertha. An outlying area is found at South Mound. From Hertha the escarpment runs westward, crossing Labette creek south of Galesburg, and follows its west bluff for a considerable distance. It is prominent at a few places on Little Labette creek and finally terminates in the mounds west of Altamont.

THE MOUND VALLEY ESCARPMENT.

The second member of the Erie formation, the Mound Valley, has very prominent exposures all the way from the Neosho river to Galesburg and for some distance south, when it suddenly fails to produce an escarpment for a considerable way, especially near Little Labette creek. At Mound Valley, however, it is very prominent continuing so to the southwest nearly to the Verdigris river at Liberty. Here, however, the limestone has disappeared and the escarpment is produced by sandstones, which are eroded further south by the tributaries of the Verdigris.

INDEPENDENCE ESCARPMENT.

The upper system of the Erie formation, the Independence, is found on the high land east of Urbana and south of that place, producing an escarpment east of Thayer, which runs in a southwest direction to the Verdigris just below Independence. Crossing to the west side of the river, it produces a high bluff all the way to Coffeyville and after a slight digression to the west at Onion creek passes into the Indian territory. Lying to the east of this escarpment, from south of

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*Haworth and Kirk: Kansas Univ. Quart., vol. II, p. 108.

Thayer to the Verdigris, is a chain of hills and mounds, including the Bender mounds and those around Cherryvale, which form a very striking feature of the country. They are simply the remains of outlying areas separated from the escarpment by erosion.

EARLTON ESCARPMENT.

The next succeeding formation is the Iola limestone formation. Below the Iola system proper lie the Earlton limestone systems. From Elk river to east of Benedict they are closely associated with the Iola; but west of Chanute and northwest of Earlton, from which place the systems take their names, they produce a separate escarpment, due to the thickening of intervening shales. Between Altoona and Earlton there are a number of mounds which have recently been protected by the limestone which produces this escarpment. The escarpment fades out in the Neosho valley, and southwest of Vilas blends with the next succeeding, which is the

IOLA ESCARPMENT.

The escarpment produced by the Iola limestone* is most prominent west of the Verdigris river from Table mound, northwest of Independence, to Benedict. South, toward the state line, it loses much of its importance, due to the preponderance of sandstone. It passes into the Indian territory just east of Tyro. Walker mound and Table mound are outlying areas of it. The prominence of the escarpment west of the Verdigris from Independence, past Neodesha, Altoona, and Guilford, to Benedict, is largely due to the position of the river valley, which runs parallel to it, and to the great thickness of the limestone. At Benedict it crosses the river and, bending somewhat to the south, takes a northerly course, passing west of Vilas, to Owl creek west of Humboldt, where the next succeeding escarpment blends with it. The Iola limestone descends to the bottom land and is not traceable far after crossing Owl creek on the west side of the Neosho river. It is exposed at Iola along Elm creek and Rock creek, as well as at several places on the east bank of the Neosho between Iola and Humboldt. At the latter place it forms the heavy ledge which is so prominent at the river bridge. Further south it recedes from the river, producing an escarpment which trends to the southeast, then curves to the northeast, running nearly parallel to Big creek, but considerably west of it, and passes just east of Moran, becoming less distinct.

CARLYLE ESCARPMENT.

This escarpment is produced by the Carlyle limestone,† which is exposed near Carlyle on both sides of Deer creek. From that place it runs to the east and then to the north, being prominent at Garnett and east of there along the Pottawatomie river. On the north side of Deer creek it trends west from Carlyle to the Neosho river, crossing it below Neosho Falls. On the west side of the Neosho it follows the river bluff for a short distance, then runs to the south, passing about half way between Iola and Piqua. At Owl creek it blends with the Iola escarpment, as already stated, although the system is traceable somewhat further to the south. North of Iola and between Iola and Humboldt, east of the river, there are a number of hills which are outlying portions of this escarpment.

CHAUTAUQUA PLATFORM AND CHAUTAUQUA SANDSTONE HILLS.

The back slopes of the escarpments thus far described possess no features which merit special description. The shale beds which produce them contain usually but little sandstone, except along the southern border of the state, and the limestones succeed each other at short intervals, so that the platforms are not very wide and their surfaces are generally undulating. West of the Iola escarpment and the Carlyle, which blends with the former, lies an area which is more diversified, due to the manner in which erosion has acted upon the heavy beds of sandstone which are present as the equivalent of the Le Roy shales* further north. North of the Neosho river sandstones are represented but sparingly in the Le Roy shales; but south of the river they gradually displace the shales, until in Chautauqua county they are everywhere predominant. From their exposure here they are named the Chautauqua sandstones. At Yates Center they become conspicuous, producing the hills upon which the town is built. From here the area broadens to the south, its eastern border passing west of Buffalo, Fredonia, and Tyro, while its western border runs approximately from Yates Center to Toronto, Fall River, Elk Falls, Sedan, and Elgin.

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*Haworth and Kirk: Kans. Univ. Quart., vol. II, p. 109.

†Haworth and Kirk: Kans. Univ. Quart., vol. II, p. 110. Since learned to be the lower member of the Garnett.

The area will here be described under the geographical name of the Chautauqua Sandstone Hills. These hills are as characteristic a feature of the southeastern part of the state as are the Flint Hills; and I here propose the name as one best applicable, since it is already employed somewhat in common usage for a portion of the area. The surface is intersected by many small streams which have deep valleys. The Verdigris, Fall and Elk rivers cross it, occupying narrow, deep channels, which are down to base level except along the western portion. The valleys of these rivers are narrow and walled in by bluffs, which show heavy sandstones as their protecting element. The low hills, which are the prominent feature of the area, are usually covered by a growth of jack-oaks. The sandy soil is seemingly adapted to their growth; for where the limestone areas are approached the oak timber begins to disappear. There are some small areas outside of the Chautauqua platform which have a similar growth of timber, as west of Thayer and south of Independence, along the west bluff of the Verdigris, where the Thayer shales,† which lie between the Independence and Iola limestones, carry a great deal of sandstone. Although the Chautauqua sandstone hills are nowhere very high, the difference in elevation over the entire surface being nowhere greater than 250 feet, yet they make traveling difficult because of the rocks which wear to the surface on the slopes, and the sand which accumulates in the wagon roads from the disintegration of the sandstones.

BURLINGTON ESCARPMENT.

The limestones exposed in Burlington‡ and just south of the town form the protecting element in the next escarpment. This escarpment, known as the Burlington, is prominent west of Le Roy Junction and along Turkey creek. It runs to the southwest, passing two miles west of Vernon and then around the head of Owl creek. The limestone is present three miles west of Yates Center; but the heavy sandstones which produce the hills at Yates Center mask the escarpment, as indeed they do in most places from there to the southern border of the state. This limestone formation is the upper limit of the Le Roy shales and Chautauqua sandstones, but the general character of the Chautauqua hills area persists to the next succeeding escarpment. The line of outcrop of the limestone is from Yates Center to Toronto, thence west of Coffeyville to Fall River, Longton, Sedan, Chautauqua Springs, and Elgin. In places the limestone, being underlaid by shales or softer sandstone, persists as a prominent element in the surface features, but where the sandstones are in heavy ledges loses its relative importance. From Sedan to Elgin it is easily traced.

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* Haworth and Kirk: Kans. Univ. Quart., vol. II, p. 110.

† Haworth: Univ. Geol. Surv., vol. I, p. 157; see also foot-note.

‡ Haworth and Kirk: Kans. Univ. Quart., vol. II, p. 110.

ELK FALLS ESCARPMENT.

The next escarpment is produced by two heavy limestone formations which are usually separated by a sandstone formation, which, weathering slowly, brings all three ledges into practically the same slope. These formations and subsequent ones are not here named, since it is not necessary to a discussion of the present subject and a strict correlation is not now possible. The escarpment is prominent west of Elk Falls. The two limestone formations produce the two heavy ledges seen along the railroad from Elk Falls to Moline. From Elk Falls southward the escarpment passes with many deep sinuosities around the head of Salt, North Caney, Middle Caney, and Cedar creeks, and leaves the state west of Elgin after having digressed up Big Caney nearly to Hewins. It is seen very prominent at Rogers, about five miles west of Sedan. Northward from Elk Falls it passes up Elk river nearly to Howard, then descends the river again; is found west of Hutchins creek; at Cave spring on the head of Indian creek; at Greenwood on Salt creek, and west of Fall river to the vicinity of Twin Falls. Thence it makes a broad bow to the east and so reaches Walnut creek, south of Neal. From there it trends to the northeast, but the character of the limestone and included sandstone formation is changing somewhat; so that it is not safe to conjecture what its equivalent is beyond where the field work has been carried in detail. The back slope of this escarpment, which is comparatively even, is spoken of locally as a limestone prairie, in contrast to the sandstone area to the east.

HOWARD ESCARPMENT.

This is a low, even escarpment which from a distance somewhat resembles artificial embankments. It is seen at Howard in the north part of town. It is produced by thin limestone capping a shale bed which weathers very easily. Riding on the railroad, one can see it very conspicuous on the west side of the track from Moline to Severy. From this place to Climax the road cuts off a portion of it to the east. Beyond Climax it is again seen west of the railroad to Fall River. South of Moline its course is indicated on the map as being to the west of Middle Caney. At Wauneta it is somewhat higher and produces the peculiar rounded hills near that place.

EUREKA ESCARPMENT.

This escarpment is very conspicuous at Eureka. The town lies in the valley of Fall river, the escarpment making a high wall to the north, west, and south. The shale bed in the face of the escarpment carries some coal at various places, and the limestone above the shale has been traced in detail to the south, and is found to be persistent though not very heavy. It would appear from a hasty reconnoissance that it caps the terrace which is prominent just west of the railroad from Eureka to Madison and at the latter place. From Eureka southward it runs in a sinuous line around the head of Honey and Tadpole creeks; is prominent on Otter creek, where the north and south branches unite; is found half way between Severy and Piedmont; passes to the west of Pawpaw creek and is prominent on Elk river about five miles west of Howard. West of Moline it is the first hill beyond the low ones in the edge of town which belong to the Howard escarpment. It has been traced to Leeds, thence south, passing west of Grant creek, and bending in an irregular course, producing the east bluff of the Caney at Cedarvale and for some distance north. To the south of Cedarvale it passes around the head of Rock creek to the state line.

REECE ESCARPMENT.

This escarpment has not been traced in detail. It is present at Reece as the most conspicuous topographic feature, and was seen at a distance in doing other field work between there and Grenola. It runs approximately parallel with the Eureka escarpment and about six miles to the west of it, but gradually approaching nearer to it southward. Half way between Moline and Grenola it may be seen to the north, forming the high hills. It then curves to the north around the head of Big Caney and blends with the eastern slope of the Flint Hills west of the creek.

UPPER LIMIT OF THE CARBONIFEROUS.

The Cottonwood Falls limestone and the bed of shales above constitute the upper member of the Carboniferous. The line of outcrop of this formation has not been traced. Prosser* has identified the formation west of Reece, Grenola, and Cedarvale. The line shown on the accompanying map as the limit of the Carboniferous is therefore only approximately correct. This formation does not produce a conspicuous escarpment, and the limestone is masked in the eastern slope of the Flint Hills.

CORRELATION WITH THE PHYSIOGRAPHIC FEATURES IN MISSOURI. †

The blending of two or more escarpments, or *vice versa*, the splitting up of an escarpment into two or more, as well as the total disappearance of others, make it appear that, if the same conditions hold in Missouri that we find in Kansas, there can be little certainty that any escarpment will continue across the two states.

The Cherokee lowlands are the equivalent of the Nevada lowlands. The Cherokee lowlands extend as a belt across the corner of Kansas. The Nevada lowlands are a continuation of this belt into Missouri, where the area narrows to a point, according to the mapping by Marbut.

South of Fort Scott the Pawnee and Oswego escarpments blend. North of the Marmaton river the escarpment thus formed passes into Missouri. I judge that it is this escarpment which, after a short curve to the east, continues northward to the Osage river, and is the one described by Marbut as entering Missouri at that place, and named by him the Henrietta escarpment. This escarpment is considered by him as the western border of the Nevada lowlands, just as the Oswego escarpment is the limit of the Cherokee lowlands. Its course in Missouri is rather an unexpected one to me, since it seems to cut across to the eastern border of the Carboniferous.

The Erie escarpment has been traced northward by Mr. Bennett to where it passes over the state line at the northeast corner of Linn county. It is probable that this escarpment continues in a sinuous course in Missouri around the head of some streams, and is the same one described by Marbut as the Bethany Falls escarpment, which he states enters Missouri in the southern part of Cass county. The region between the Henrietta and Bethany Falls escarpments has been called by him the Warrensburg platform. To the west of the Bethany Falls escarpment Marbut describes the Lathrop platform and the Marysville lowlands. It is not possible here to give the Kansas equivalents of these belts, since a large area intervenes which I have not studied. It would appear, however, that in Kansas the escarpments described, or others similar, continue to the Missouri river.

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* Kans. Univ. Quart., October, 1897.

† Marbut, Geol. Surv. of Missouri, vol. X.